

Remarks

Favorable reconsideration is respectfully requested.

The claims are 1 and 10-13.

The above amendment presents a revised set of claims wherein amended claim 1 combines features from previous claims 1, 5 and 8. Support is evident from the original claims as well the disclosure at page 7, first full paragraph of the specification.

The significance of this amendment will become further apparent from the remarks below.

1. Please note that the proton-supplying material is now defined in amended claim 1 as polymeric acid having, in the molecule thereof, an acidic group selected from the group consisting of a carboxyl group a sulfonic acid group, a sulfuric acid group, a phosphoric acid group and a phosphonic acid groups, as described on page 6, lines 4 to 7, and not an acidic group selected from carboxyl, sulfonate, sulfate, phosphate, and phosphonate groups. The polymeric acid is preferably crosslinked with a crosslinking agent, as recited in new claim 11 (and previous claim 6).

According to the present claims, at least an anode of the fuel cell carries a polymeric acid as mentioned above as a proton-supplying material, so that, in the case where the anode has platinum or platinum-ruthenium alloy as an electrode catalyst, the electrode catalyst of the anode is restrained from being poisoned even if hydrogen containing carbon monoxide is supplied to the anode as a fuel; consequently, there can be obtained a fuel cell of high power (page 3, lines 22-28).

In particular, by the use of a crosslinked polymeric acid as the proton-supplying material, as recited in new claim 11, the carrying stability of the proton-supplying material on the electrode increases so that a drop in the power density can be suppressed to a low level even if the fuel cell is driven for a long time of 500 hours (page 3, lines 28-33), as demonstrated in Example 5 (starting on page 25 of the specification).

2. Claims 1-3 have been rejected under 35 U.S.C 102(b) as being anticipated by JP 10-334922 (JP '922).

This rejection is respectfully traversed.

JP '922 discloses a solid polymer electrolyte fuel cell in which a catalyst layer of at least a cathode (an oxygen electrode) contains a "water retention agent", which is exemplified by sulfuric acid.

The fuel cell as recited in amended claim 1 contains no mineral acid inclusive of sulfuric acid in either electrode. Hence, the rejection based on JP '922 is inapplicable to the present claims.

3. Claims 1, 2, 4, 5 and 7 have been rejected under 35 U.S.C. 102(b) as being anticipated by WO 01/43215, or Abe et al., U.S. 2003/0113611 (Abe '611). These references are essentially equivalent as noted by the Examiner, so only Abe '611 will be discussed.

This rejection is also respectfully traversed.

Abe '611 discloses a fuel cell in which at least one of the cathode and the anode comprises an electroconductive porous substrate, an inorganic catalyst such as platinum, and an electroconductive organic polymer having a dopant, as an electrode catalyst, and the dopant is preferably an ionic polymer sulfonic acid such as polyvinyl sulfonic acid or phenolsulfonic acid novolac resin [0013].

Accordingly, while in the fuel cell of Abe '611, at least one of the electrodes comprises an ionic polymer sulfonic acid, it should be noted that the ionic polymer sulfonic acid is used as a dopant for an organic polymer, so that the resulting organic polymer, thus doped with the ionic polymer sulfonic acid, is electroconductive, and it effectively functions as an electrode catalyst in the fuel cell.

This means that the organic polymer is electroconductive only when it has a dopant, and the organic polymer is not electroconductive without the dopant. The fuel cell of Abe '611 needs such an electroconductive organic polymer doped with the ionic polymer sulfonic acid.

Thus, Abe '611 does not disclose or suggest that the anode carries an ionic polymer sulfonic acid or a polymeric acid apart from an organic polymer. In other words, Abe '611 does not disclose or suggest that the anode carries an ionic polymer sulfonic acid or a polymeric acid alone without the organic polymer.

More importantly and fundamentally, when an organic polymer, for example, such as the polyaniline of Abe '611, is doped with an ionic polymer sulfonic acid, and is hence electroconductive, the ionic polymer sulfonic acid (an acid) protonates the nitrogen atoms of amino groups of the polyaniline (a base) whereby the polyaniline and the ionic polymer sulfonic

acid form in combination, a salt composed of an acid and a base. In other words, the ionic polymer sulfonic acid is neutralized with the polyaniline to form a salt.

In addition, as known, a polymer acid is in general much more firmly doped to or much more strongly adhered to an organic polymer, than an inorganic mineral acid such as sulfuric acid, because the polymer acid has an elongated molecular chain with a large molecular weight and has a number of acidic group in the molecule bonded to the molecular chain so that it has a much stronger interaction with the organic polymer whereby it effectively functions as a dopant to make the organic polymer electroconductive.

Therefore, when polyaniline is doped with the ionic polymer sulfonic acid and is made electroconductive, the ionic polymer sulfonic acid is so firmly combined with the polyaniline that it is hardly freed from or dedoped from the polyaniline.

Thus, when the ionic polymer sulfonic acid of Abe '611 is used as a dopant for an organic polymer such as polyaniline, and forms a salt together with the polyaniline, the ionic polymer sulfonic acid can not provide any protons with a catalyst layer, in particular, in the neighborhood of noble metal particulate electrode catalyst.

Accordingly, the ionic polymer sulfonic acid acting as a dopant for an organic polymer such as polyaniline in Abe '611 has no function of a protonic acid, and hence is in no way an equivalent to or suggestive of the proton-supplying material or protonic acid as defined in the present claims.

In view of the foregoing, the presently claimed fuel cell is not anticipated or suggested by Abe '611.

4. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over WO 01/43215 (Abe '611).

The subject matter of claim 8 has been incorporated in amended claim 1.

As discussed above, if at least one of the electrodes of the fuel cell of Abe '611 comprises an ionic polymer sulfonic acid as a dopant to make an organic polymer electroconductive, the ionic polymer sulfonic acid has no function as a protonic acid.

Thus, the ionic polymer sulfonic acid is neither an equivalent of the proton-supplying material or protonic acid as defined in the present claims, nor suggestive of a proton-supplying material.

Therefore, the claimed fuel cell is not at all suggested by Abe '611.

5. Claims 6 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over WO 01/43215 (Abe '611) in view of Fuglevand et al. (U.S. No. 6,218,035).

This rejection is respectfully traversed.

Fuglevand et al. describes a proton exchange membrane (PEM) fuel cell which includes a membrane electrode diffusion assembly (MEA) comprising: a solid proton conducting electrolyte membrane (PEM or an electrolyte); a catalytic anode and a catalytic cathode disposed in contact with the anode and the cathode; and a gas diffusion layer disposed in contact with both of the anode and cathode (column 4, lines 12-23).

It is well known that PEM fuel cells can operate at higher power output levels when supplemental humidification is made available to the PEM (electrolyte) (column 2, line 65 to column 3, line 1).

Thus, Fuglevand et al. discloses a PEM fuel cell in which the PEM is self-humidified. More specifically, the gas diffusion layer of Fuglevand et al. has a hydrophobic gradient so that sufficient water is retained in the PEM (column 11, lines 40-41).

Fuglevand et al. give the details of the structure and manufacture of the gas diffusion layer in connection with the hydrophobic gradient therein.

However, Fuglevand et al. make little mention of the catalytic layer, much less about fabrication of the catalytic layer. Fuglevand et al. confess that "a number of commercially available membrane electrode assemblies (MEA) are fabricated which have a preexisting property diffusion layer attached to same, the composition of which is unknown to the inventors (column 9, lines 40-43). In fact, for instance, in Example 1, "(t)he diffusion layers were affixed to a commercially available membrane electrode diffusion assembly such as that which may be secured from the W. L. Gore Company under the trade designation Primea Series 6000 (column 13, lines 56-59).

As discussed above, Fuglevand et al. makes use of commercially available MEA, and therefore Fuglevand et al. is inaccurate or misleading in stating, for example, that "the individual anode and cathode electrodes 161 and 162 comprises particulate carbon; a catalyst such as platinum or the like; and a crosslinked copolymer incorporating sulfonic acid groups" (column 10, lines 8-11).

More specifically, it is the solid electrolyte membrane of Fuglevand et al. which comprise crosslinked polymeric chains having sulfonic acid groups, and the crosslinked polymeric chains comprise methacrylates (column 4 lines 24-27; and column 18, lines 22-25).

Therefore, it is clear that the catalytic layer of the proton exchange membrane fuel cell of Fuglevand et al. does not contain crosslinked polymeric chains having sulfonic acid groups.

In contrast, according to the present invention, the anode comprises an electroconductive porous substrate which carries thereon platinum or a platinum alloy and a proton-conductive ion exchange electrolytic polymer, and further at least the anode carries a polymeric acid as claimed in amended claim 1, and such a fuel cell as claimed has unexpected advantages as described hereinbefore and below.

The electrode catalyst of the anode is restrained from being poisoned even if hydrogen containing carbon monoxide is supplied to the anode as a fuel; consequently, a fuel cell having high power can be obtained. In particular, by the use of a proton acid crosslinked with a crosslinking agent as the proton-supplying material, as recited in new claim 11, the carrying stability of the proton-supplying material on the electrode increases so that a drop in the power density can be suppressed into a low level even if the fuel cell is driven for a long time of 500 hours, as mentioned above.

Thus, the present invention relates to improvement in a catalytic layer so that the electrode catalyst of the anode is restrained from being poisoned even if hydrogen containing carbon monoxide is supplied to the anode as a fuel; consequently, a fuel cell having a high power can be obtained.

On the other hand, Fuglevand et al. relates to improvement in a gas diffusion layer so that the gas diffusion layer has a hydrophobic gradient so that sufficient water is retained in the PEM, i.e., a PEM fuel cell in which the PEM is self-humidified, and therefore, Fuglevand et al. have nothing to do with the present invention.

From the foregoing, it is clear that the presently claimed fuel cell is totally and obviously different from the fuel cell of Fuglevand et al., and accordingly, the presently claimed fuel cell is in no way suggested by Abe '611 even in view of Fuglevand et al.


For the foregoing reasons, it is considered that the rejections on prior art are untenable and should be withdrawn.

No further issues remaining, allowance of this application is respectfully requested.

If the Examiner has any comments or proposals for expediting prosecution, please contact undersigned at the telephone number below.

Respectfully submitted,

Megumu NAGASAWA et al.

By: 
Matthew M. Jacob
Registration No. 25,154
Attorney for Applicants

MJ/jmj
Washington, D.C. 20005-1503
Telephone (202) 721-8200
Facsimile (202) 721-8250
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